*Desalination and Water Treatment*
www.deswater.com

doi: 10.1080/19443994.2015.1054315

57 (2016) 12822–12831
June

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# Adsorption of malachite green and crystal violet cationic dyes from aqueous solution using pumice stone as a low-cost adsorbent: kinetic, equilibrium, and thermodynamic studies

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Received 28 February 2015; Accepted 15 May 2015

**ABSTRACT**

In this study, the sorption potential of pumice was investigated as geomaterial adsorbent for removal of two cationic dyes, malachite green (MG) and crystal violet (CV), from aqueous solution. In batch experiments, the effects of contact time, particle size, absorbent dose, solution pH, initial dye concentration, and temperature of MG and CV ions on the pumice adsorption capacity was studied. The characterization of the pumice has been accomplished by X-ray fluorescence spectroscopy, scanning electron microscope, and Brunauer–Emmett–Teller technologies. Equilibrium data were accurately fitted onto Langmuir, Freundlich, and Temkin isotherms. The results showed that the adsorption isotherm data were fitted well to the Langmuir isotherm and the maximum adsorption capacities calculated were 22.57 and 6.99 mg/g for MG and CV at 25°C, respectively. The kinetic data for both dyes were better described by the pseudo-second-order kinetic model. The thermodynamic parameters such as $\Delta G^{\circ}$, $\Delta H^{\circ}$, and $\Delta S^{\circ}$ were also evaluated. The positive $\Delta H^{\circ}$ and $\Delta S^{\circ}$ values described endothermic nature of the adsorption and the affinity of pumice for MG and CV adsorption, respectively. It is expected that pumice can be considered as a low-cost adsorbent for the removal of dyes from wastewater.

*Keywords:* Pumice; Malachite green; Crystal violet; Adsorption; Kinetics; Thermodynamics

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